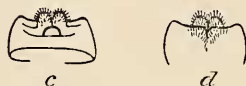


It is probable that other described Madagascan insects belong also to the genus.



Genitalia of *Adorodocia*.

a, ♂, lateral view; *b*, end view.
c, ♀, ventral view; *d*, dorsal view.

In order more effectually to correct my mistake as to the genitalia of these insects, I reproduce here the figures given last month, with the correct description of them.

XXIX.—*A Revision of the Butterflies of the Genus Precis, with Notes on the Seasonal Phases of the Species.* By ARTHUR G. BUTLER, Ph.D.

DURING a recent rearrangement of the Museum collection of the genus *Precis* I paid particular attention to the seasonal variation of the species, which, as Mr. Guy A. K. Marshall and others have pointed out, are often very remarkable. I found that by carefully studying the characters already noted by observant collectors there was in no case any difficulty in distinguishing the dry and wet phases, although the determination of the intermediate phase was necessarily somewhat arbitrary.

In the African forms of *Precis* the wet phase is, I believe, invariably smaller than the dry phase; but in the Oriental types this rule is usually reversed. This would tend to show that the dry phase in Africa had been better nourished and probably been a shorter time in the pupal condition than that of the Asiatic and Australasian forms.

The dry phase throughout the genus tends to have a more falcate form of front wing and a far more leaf-like character of under surface than the wet phase; in many species also the ocelli on the wings are reduced to mere points in the dry season, as in the *Satyrinæ*.

In several cases where it had been surmised that one

described form was a seasonal phase of another I have been able to establish the fact by the discovery of the intermediate phase. I am therefore certain that my study of this interesting genus will prove useful to lepidopterists.

As regards the species or subspecies which I have kept separate, I do not propose to make any dogmatic statement. I believe that the various forms of the *P. orithya* group are constant in certain characters, slight though the differences may sometimes be; but whether they be regarded as species or local forms is a matter for individual judgment. I never could define the exact amount of constant difference which was necessary to distinguish a local form from a species. At the same time in the forms of *P. erigone* which I have named, the differences being mostly indicated by tint, I think all will be agreed that they are no more than local modifications, even if they prove to be absolutely constant, as I think they will. On the other hand, the named forms of *P. almana* are certainly not constant.

1. *Precis villida*.

Papilio villida, Fabricius, Mant. Ins. ii. p. 35 (1787).

Papilio velleda, Fabricius, Ent. Syst. 3, p. 91 (1793).

Junonia vellido, Kirby, Cat. Diurn. Lep. p. 188 (1871).

Vanessa calybe, Godart, Enc. Méth. ix. p. 317 (1819).

Cynthia hampstediensis, Stephens, Ill. Brit. Ent. i. p. 48, pl. v. figs. 3, 4 (1827).

Wet phase.—Gilbert, Ellice, and Navigator Islands, and Viti Levu. B. M.

Intermediate wet.—Aneiteum, Vaté, Ovalau, Mango, New Ireland, New Guinea, Tasmania, Port Darwin. B. M.

Intermediate dry.—Java, Christmas Island, Roebuck Bay, Sydney, Moreton Bay, Champion Bay, Toowoomba, Port Darwin. B. M.

Dry phase.—Condillac Island, near Lord Howe's Island, Tasmania, Queensland.

The wettest development of the species is found in the Ellice Islands and the driest in Tasmania.

2. *Precis vestina*.

Junonia vestina, Felder, Reise der Nov., Lep. iii. p. 398 (1867).

Bolivia and Ecuador (Coll. Hewitson); Peru. B. M.

So far as I have been able to judge this is an insect only having a dry-season phase; at any rate, all the examples which I have seen represent that phase, even when obtained during the rainy season; there is, however, a variation in the

ground-colour of the under surface from rosy clay-colour to ashy grey, which may be seasonal.

When quite fresh this insect bears a remarkable superficial resemblance to *Vanessa urticæ* of Europe.

3. *Precis Hübneri*.

Precis Hübneri, Kirby, in Hübner's Exot. Schmett. ed. 2 (1900), p. 24.

Hamadryas decora evarete, Hübner, Exot. Schmett. i. pl. lii. figs. 1, 2.

Junonia lavinia, Staudinger, Exot. Schmett. pl. xxxvii.

Rio Janeiro and Pará. B. M.

This insect undoubtedly differs considerably from *P. lavinia* of Cramer, the white belt across the primaries being entirely replaced by tawny orange; in the dry phase the orange banding almost entirely disappears, with the exception of the bars across the discoidal cell.

Although it is possible that the white belt in Cramer's figures may only indicate a rare variation answering to *P. genoveva* (of which *P. flirtea* is a tawny-banded form), the lack of examples from Surinam renders it impossible to be certain.

4. *Precis occidentalis*.

Junonia occidentalis, Felder, Wien. ent. Monatschr. vi. p. 110 (1862).

Junonia pallens, Felder, Reise der Nov., Lep. iii. p. 401 (1867).

Pará and Buenos Ayres. B. M.

The primaries, especially of the males, are more produced and the entire colouring of both surfaces is much paler than in *P. Hübneri*. Without positive evidence it would be premature to regard it as a variety of that insect, just as it would be to assume that *P. Hübneri* was a variety of *P. lavinia*.

5. *Precis hilaris*.

Junonia hilaris, Felder, Reise der Nov., Lep. iii. p. 400 (1867).

Paraguay.

We do not possess this insect, and therefore I cannot express an opinion as to its distinctness from *P. lavinia*.

6. *Precis lavinia*.

Papilio lavinia, Cramer, Pap. Exot. i. pl. xxi. C, D (1775).

Papilio larinia, Fabricius, Ent. Syst., Suppl. p. 424 (1798).

Junonia negra, Felder, Reise der Nov., Lep. iii. p. 399 (1867).

Junonia divaricata, Felder, t. c. p. 401 (1867).

Surinam and Rio Negro.

We do not possess typical examples of this species, and therefore cannot assert that the preceding three named forms are distinct.

7. *Precis evarete*.

♀. *Papilio evarete*, Cramer, Pap. Exot. iii. pl. cciii. C, D (1782).

Papilio genoveva, Cramer, Pap. Exot. iv. pl. ccxc. E, F (1782).

Papilio esra, Fabricius, Ent. Syst., Suppl. p. 425 (1798).

Junonia zonalis, Felder, Reise der Nov., Lep. iii. p. 399 (1867).

Junonia incarnata, Felder, t. c. p. 595 (1867).

Var. *Papilio flirtea*, Fabricius, Ent. Syst. iii. 1, p. 90 (1793).

Junonia oriana, Kirby, in Hübner's Exot. Schmett. ed. 2 (1900), cf. Hübner, vol. i. pl. l. figs. 3, 4.

West Indies, Central America, and Bogota. B. M.

This species has always gone by the name of *P. genoveva*; but *P. evarete* seems to me to be clearly the female of the dry phase of this species, males of which we have from Honduras and Nicaragua. *P. zonalis*, of which we have a male from Bogota, is an intermediate phase with rather a broad oblique belt across the primaries; *P. flirtea* is a form in which the oblique band on the primaries becomes opaque and tawny ochreous—we have it from the island of Dominica, Honduras, the Polochic Valley, and Mexico. I have not regarded it as distinct, because it evidently occurs with *P. genoveva* in Honduras and Central America; but a study of the early stages may prove it to be so.

8. *Precis constricta*.

Junonia constricta, Felder, Reise der Nov., Lep. iii. 1, p. 400 (1867).

Bogota. B. M.

In this insect the oblique band across the primaries from the costal vein to the ocellus is very narrow and the general colour is slightly paler than in typical *P. evarete*. In the absence of examples tending to link it to the latter, it seems better to regard it as distinct.

9. *Precis fuscescens*, sp. n.

General character of *P. evarete*, but the forked belt on the primaries and submarginal orange belt on the secondaries narrow and more or less suffused with brown, that of the secondaries wanting in the dry phase; ocelli of primaries without orange irides; the dry phase also without orange in cell-spots.

Expanse of wings 54–58 millim.

Porvenir, Ecuador, and Quito. B. M.

10. *Precis infuscata*.

Junonia infuscata, Felder, Reise der Nov., Lep. iii. p. 401 (1867).

Junonia basifusca, Weymer, in Stubel's Reise, p. 120, pl. iii. fig 7 (1890).

Guayaquil. B. M.

The dry phase of this species loses all the defined brown belts from the under surface of the secondaries, which become almost uniformly lilacine grey traversed by brownish lines. The bands above are rather pale buff than pale brown, as Felder describes them.

11. *Precis cænia*.

Junonia cænia, Hübner, Samml. exot. Schmett. ii. pl. xxxii. (1816-24).

Wet phase.—Texas, Bermudas. B. M.

Intermediate phase.—California. B. M.

Dry phase.—California and Bermudas. B. M.

In the driest phase the under surface of the secondaries is rosy clay-coloured.

There is generally no difficulty in distinguishing this at a glance from *P. evarete*, on account of the great disproportion in the size of the ocelli on the secondaries, but the white inner border to the posterior ocellus on the primaries is a still more reliable character; the secondaries on the under surface differ considerably in the two species, the ground-colour being much darker in *P. evarete*, the wet phase showing a defined straight pale band across the middle, sharply defined ocelli, and pale external area.

The species of the succeeding group are nearly related, and consequently have generally been confounded, even such experienced entomologists as Messrs. de Nicéville and F. Moore having failed to note the distinctions which separate the Chinese *P. orithya* from the Indian *P. Swinhoei*. The differences of all the forms, which appear to be locally constant, are such as are nowadays frequently regarded as subspecific; it is, however, as already observed, impossible to define the exact amount of constant difference which is required to indicate whether a separate evolution be regarded as a species or a subspecies, so I separate all these constantly differing forms as species.

12. *Precis orithya*.

Papilio orithya, Linnæus, Mus. Lud. Ulr. p. 278 (1764).

Junonia Leechi, Alpheraky, Rom. Mém., Lép. ix. p. 103 (1897).

Western and Northern China, Foo Chow, Hong Kong, Hainan, Formosa, Madjico Sima, Loo-Choo. B. M.

The Chinese insect is, as a rule, larger than the Indian one, the males show barely a trace of the blue patch at external angle of the primaries above, the outer border is less suffused with blue and frequently shows no trace of this suffusion, whereas in *P. Swinhoei* this suffusion is rarely absent; the ocelli on

the secondaries of the female are usually very large, sometimes even connected, and have large pearly blue centres; the external half of the female is often ashy fuliginous instead of blue, the orange markings on all the wings above being well developed in this variety. The under surface of the males is greyer below and *that of the females shows much more orangetawny on the secondaries* than in *P. Swinhoei*. In the dry phase the under surface of the secondaries varies from vinous ash to different shades of rufescent ashy brownish; in *P. Swinhoei* the variation is much greater, the secondaries sometimes heavily lined and banded, sometimes almost white, with the markings much divided up. Leech's figures show the seasonal phases fairly well.

13. *Precis Royeri*.

♀. *Vanessa Royeri*, Vollenhoven, Tijds. voor Ent. iv. p. 157, pl. viii. figs. 1, 2 (1861).

♂. *Junonia orbitola*, Swinhoe, Ann. & Mag. Nat. Hist. (6) xii. p. 207 (1893).

Var. ? *Junonia orithyia*, var. *neopommerana*, Ribbe, Iris, vol. xi. p. 116 (1898).

♂ ♂, Saparea Island and New Guinea. B. M.

The well-defined orange belt on the under surface of the secondaries at once determines this species; there is no other form with the same character. The female, as figured by Vollenhoven, is also very characteristic.

14. *Precis ocyale*.

♂ as ♀. *Junonia ocyale*, Hübner, Samml. exot. Schmett. ii. pl. xxxiii. figs. 3, 4 (1816-1824).

Java and Celebes. B. M.

Hübner figures two males under this name: figs. 1, 2 represent the intermediate phase of *P. Swinhoei*, so that figs. 3, 4 will retain his name (as understood by recent authors); they represent the dry phase, each sex of the wet phase showing a great deal of reddish orange on both surfaces.

15. *Precis Wallacei*.

Junonia Wallacei, Distant, Rhop. Mal. p. 95, pl. xi. figs. 3, 4 (1883).

Malacca (*Pinwill*), Sarawak (*Bartlett*). B. M.

The Philippine form may possibly belong to this type, but we only have a male of it. The females of *P. Wallacei* are very characteristic, the outer half of the secondaries being either buff or ashy brownish instead of blue; the oblique belt on the primaries of both sexes is creamy white and barely interrupted by a few orange scales.

16. *Precis albicincta*.

Junonia albicincta, Butler, Trans. Ent. Soc. 1875, p. 5.

N. Australia, Baudin, Damnia, and Semaio Islands. B. M.

The borders of the males are *very white* and destitute of blue scaling, the seasonal forms well defined; the ocelli in both sexes above small.

17. *Precis Swinhoei*.

Junonia Swinhoei, Butler, Ann. & Mag. Nat. Hist. (5) xvi. p. 309 (1885).

Junonia Alleni, Kirby, Hübner's Exot. Schmett. ed. 2, pl. 246 (33), figs. 1, 2 (1900).

India and Burma. Type, B. M.

This is generally a small species with well-defined blue patch at external angle of primaries in the male.

18. *Precis here*.

Junonia here, Lang, Entom. xvii. p. 207 (1884).

Bagdad (*Loftus*), Aden (*Yerbury*). Type, B. M.

This form differs chiefly from *P. Swinhoei* in the distinctly bluer outer border to the secondaries; it appears only to have a dry phase. From *P. boopis* it is more difficult to separate it, the orange iris to the upper ocellus of the primaries, upon which Mr. Lang partly relied, being not quite a constant character; it is more uniformly small than *P. boopis*, and is perhaps rather paler on the under surface, but to all intents and purposes it is a mere local race of that form. As regards size, we have much smaller examples of the nearly related *P. Swinhoei*, only *P. here* appears to vary very little in this respect, and the absence of wet and intermediate phases may perhaps be allowed to weigh somewhat as a reason for regarding it as subspecifically distinct from *P. boopis*.

19. *Precis boopis*.

Junonia boopis, Trimen, Trans. Ent. Soc. 1879, p. 331.

Eastern Africa from north to south. B. M.

20. *Precis clelia*.

Papilio clelia, Cramer, Pap. Exot. i. pl. xxi. E, F (1775).

Africa generally and Aden. B. M.

The seasonal forms are well-defined by the colouring of the under surface, the wet phase having the central pale belt across the middle of the secondaries well-defined by the

darkening of the subbasal markings and discal area, the small ocelli on this area being tolerably sharply outlined; in the intermediate phase the central belt and border are not so white, and many of the specimens show a slight rosy suffusion; in the dry phase the ocelli on the under surface are, as a rule, reduced to mere points, the general character of colouring is more leaf-like, varying from rosy brownish to ochreous brownish, the darker areas frequently much less defined. The tendency in the dry phase evidently is for the resting butterfly to resemble a dead leaf.

21. *Precis epiclelia*.

Vanessa epiclelia, Boisduval, Faune Ent. de Madag. p. 44, pl. vii. fig. 3 (1833).

Madagascar (Betsileo). B. M.

This is an island form of *P. clelia*, differing chiefly in the reduced size of the creamy-white markings on the primaries. As with other species found in Madagascar, the seasonal phases seem to be less defined than in those from the continent of Africa.

22. *Precis ænone*.

Papilio ænone, Linnæus, Mus. Lud. Ulr. pp. 274, 275 (1764).

Papilio hierta, Fabricius, Ent. Syst., Suppl. p. 424 (1793).

China, Burma, Pegu, Mergui, Andamans, Nicobars, Ceylon, India generally. B. M.

Specimens from China are so large that they might be regarded as representing a distinct subspecies if it were not for the existence of occasional equally large examples from Northern India; the Museum has such examples from Karachi in the west and Assam in the east.

The seasonal phases differ in the usual way, the markings in the wet phase on the under surface being fairly well defined, but in the dry phase blurred on the secondaries, which are of a more uniformly greyish ashy tint.

23. *Precis cebrene*.

Junonia cebrene, Trimen, Trans. Ent. Soc. 1870, p. 353. ("*cebrene*," Dunning, t. c. p. 524.)

Africa generally and Aden. B. M.

The seasonal phases differ much as in *P. ænone*, but the differences between the extremes are perhaps a little more pronounced.

24. *Precis paris*.

Junonia paris, Trimen, S. African Butt. i. p. 212 (1887).

Madagascar.

I have not seen this species, but it is said to differ from *P. cebrene* in the broader basal black area on the upper surface of the primaries showing two blue striæ in the discoidal cell and the consequent reduction of the ochreous area on these wings. The blue spot on the secondaries is described as being larger, not violaceous and prolonged outwardly on the radial vein; but these characters may prove to be inconstant if one may judge of them by what we see in the closely related *P. ænone* and (to some extent) in *P. cebrene*.

25. *Precis Westermanni*,

Junonia Westermanni, Westwood, Ent. Mo. Mag. vi. p. 278 (1870);
Thesaurus Oxon. p. 182, pl. xxxiv. figs. 7, 8 (1874).

Western and Eastern Africa, ♂♂ ♀♀. B. M.

Although the pattern of the under surface in the wet phase of this species somewhat approaches that of *P. sophia*, the upper-surface colouring would bring it next to *P. paris*. As a matter of fact *P. Westermanni* and *P. hadrope* stand quite alone, the sexes in both being utterly dissimilar. A female of *P. Westermanni* was secured by the late Mr. Philip Crowley, and we have recently received two others; and *P. ixia*, of which the Museum possesses the type, is evidently the female of *P. hadrope*.

The dry phase of *P. Westermanni* is smaller than the wet phase, and the secondaries on the under surface are rufescent, with rufous-brown, instead of black, markings, and with a slightly silvery triangular costal patch.

26. *Precis sophia*.

Papilio sophia, Fabricius, Ent. Syst. iii. 1, p. 248 (1793).

Western Africa generally. B. M.

What appears to be the dry phase of this species is evidently a rare insect, in which the upper surface is almost black, with the discal bands white, so that it looks remarkably like a tiny form of *Panopea lucretia*. In the Museum collection are two examples of a phase intermediate between this and the normal wet phase.

27. *Precis infracta*.

Junonia infracta, Butler, P. Z. S. 1888, p. 63.

Eastern and E. Central Africa. Type, B. M.

The phases appear to differ much as in *P. sophia*, excepting that the intermediate and dry phases are far less rare.

28. *Precis hadrope*.

♂. *Junonia hadrope*, Westwood and Hewitson, Gen. Diurn. Lep. pl. xxv. fig. 2 (1847).

♀. *Junonia ivia*, Butler, Ent. Mo. Mag. ii. p. 227 (1866).

Western Africa. Types, B. M.

From the material which we possess it is impossible to be certain as to the seasonal differences; but it would seem that the ocelli are reduced and the under surface of the secondaries becomes paler and less distinctly marked in the dry phase.

29. *Precis octavia*.

Papilio octavia, Cramer, Pap. Exot. ii. p. 60, pl. cxxxv. B, C (1777).

Papilio amestris, Drury, Ill. Exot. Ent. iii. p. 26, pl. xx. figs. 3, 4 (1782).

Western and Northern Africa to the Albert Nyanza and Somaliland on the East. B. M.

We have a perfect gradation from the extreme wet phase *P. octavia* to the extreme dry phase indistinguishable from *P. sesamus*; of the latter, however, we have only one imperfect example from Onitsha on the Niger, the ordinary dry phase of the West Coast being represented by a less blue form—*P. amestris*. In *P. octavia*, which never attains to the size or rich colouring of its Eastern representative, the belt crossing the end of the cell in the primaries is generally unbroken, whereas in *P. natalensis* it is always widely interrupted.

30. *Precis sesamus*.

Precis sesamus, Trimen, Trans. Ent. Soc. 1883, p. 347; S. Afr. Butt. i. p. 231, pl. iv. fig. 3 (1887).

Precis octavia, var. *natalensis*, Staudinger, Exot. Schmett. i. p. 101 (1885); also *P. amestris*, var. *caffraria*, pl. xxxviii.

Junonia calescens, Butler, P. Z. S. 1893, p. 652 (1894).

Precis sesamus (int. phase), Butler, P. Z. S. 1900, p. 916, pl. lviii. fig. 1.

Southern and Eastern Africa. B. M.

The gradual transitions between the extreme phases of this form do not seem to exist, as in the western *P. octavia*; the intermediate phase seems always to show a mass of salmon-colour on the upper surface and to vary chiefly in the distribution of the blue colour which connects it with the typical dry phase.

31. *Precis antilope*.

Salamis antilope, Feisthamel, Ann. Soc. Ent. Fr. 1850, p. 250.

Precis simia, Walleugren, Kongl. Svensk. Vet.-Akad. Handl. 1857, Lep. Rhop. Caffr. p. 26.

Precis ibris, Felder, Reise der Nov., Lep. p. 403 (1867).

Precis Peterst, Dewitz, Nov. Ac. Acad. Nat. Cur. xli. 2, p. 192, pl. xxv. fig. 14 (1879).

Junonia micromera, Butler, Ann. & Mag. Nat. Hist. (4) vol. xviii. p. 482 (1876).

Eastern and Southern Africa. B. M.

P. antilope is the dry phase and *P. simia* (= *micromera*) the wet. We possess an intermediate phase approaching nearest to *P. antilope*. From *P. cuama*, with which the dry phase has been confounded, there is no difficulty whatever in distinguishing it. The wings in all phases of *P. antilope* are shorter, the pink belt on the secondaries of the males wanting, as also the subapical white spots on the dry phase; there are other constant, though less evident, differences.

32. *Precis cuama*.

Junonia cuama, Hewitson, Exot. Butt., *Jun.* pl. i. figs. 4, 5 (1864).

Junonia Trimeni, Butler, P. Z. S. 1893, p. 651, pl. lx. fig. 4 (1894).

East Africa southwards to Mashonaland. B. M.

P. cuama is the dry phase and *P. Trimeni* the wet. We have several transitional examples. As to *P. cuama* being an aberration of *P. antilope*, that is out of the question, from the constancy of all its characters in both wet and dry phases and in the fact that it is quite as abundant (where it occurs) as *P. antilope*.

33. *Precis ceryne*.

Salamis ceryne, Boisduval, Voy. Deleg. ii. p. 592 (1847).

Southern and Eastern Africa. B. M.

The dry phase differs in the much more pronounced angles to the outer margins of the wings, in the much more uniform redder colouring of both surfaces, with less prominent white discal spots and absence of white submarginal lunules. We have two transitional examples.

34. *Precis pelarga*.

Papilio pelarga, Fabricius, Syst. Ent. p. 513 (1775).

Papilio leodice, Cramer, Pap. Exot. ii. pl. cxxxviii. G, H (1779). Cf. also Aurivillius, Rhop. Æthiop. pp. 138, 139, for other synonyms.

Vanessa laodora, Godart, Enc. Méth. ix. p. 314 (1819).

Vanessa Galami, Boisduval, Faune Ent. de Madag. p. 46 (1833).

Precis monroviaana, Staudinger, Exot. Schmett. p. 100 (1885).

Western and Equatorial Africa. B. M.

The wet form is small, and is doubtless the *P. Galami* (described, by comparison with *P. andreminja*, in the Faune Ent. de Madagascar); in this form both sexes have a more or less fulvous belt across the wings, sometimes white washed with fulvous, as M. Boisduval says. In the dry form, which is much larger and with strongly falcate primaries, the male has an orange belt touched with bluish white towards the abdominal margin; the female has the belt blue, with tawny orange outer border.

35. *Precis actia*.

Precis actia, Distant, P. Z. S. 1880, p. 185, pl. xix. fig. 7.

♀. *Precis vetula*, Staudinger, Exot. Schmett. i. p. 101 (1885).

East Africa. B. M.

The dry phase is the one described, and differs markedly from that phase of *P. pelarga* in always showing more or less blue inner shading to the discal belt in both sexes, and in the double angulation of the outer edge of the brown basal three fifths of the primaries. The wet phase is probably confounded in most collections with *P. Galami*, from which the double angulation of the outer edge of the basal area and the pure white defined belt which occupies the inner two thirds of the discal belt in the female at once distinguish it. We have two examples of an intermediate phase from Nyasaland in which both sexes show a slight shade of blue on the more restricted white portion of the discal belt towards the abdominal margin of secondaries, but retain the non-falcate form of primaries.

We now come to a group of species in which the colouring of the upper surface is tolerably uniform at all seasons and that of the under surface always more or less leaf-like in character. One of these, which used to be widely separated from *Precis* and placed near *Kallima*, I characterized as a new genus under the name of *Coryphæola* in 1878; but Prof. Aurivillius has correctly pointed out (Rhop. Æthiop. p. 131) that it agrees both in structure and character of marking with *Precis*.

36. *Precis sinuata*.

Precis sinuata, Plötz, Stett. ent. Zeit. 1880, p. 477.

Precis pelargoides, Aurivillius, Ent. Tidskr. xii. p. 204 (1891).

Precis serena, Weymer, Stett. ent. Zeit. 1892, p. 86.

West Africa. B. M.

I have no doubt, if I have correctly identified *P. pelargoides*, that it represents the wet phase of this species, from

which it differs in its inferior size, less falcate primaries, more opalescent discal belt, deeper coloured more varied under surface, with submarginal pearly white lunules; the primaries washed with purplish.

37. *Precis milonia*.

Precis milonia, Felder, Reise der Nov., Lep. p. 403 (1867).

Precis kowara, Ward, Ent. Month. Mag. viii. p. 22 (1871); Afr. Lep. p. 6, pl. v. figs. 5, 6 (1873).

Var.?, *Junonia rauana*, Gr.-Smith, Nov. Zool. v. p. 352 (1898).

West and East Africa. B. M.

I have only seen the wet phase of this species, of which there are four examples from the Cameroons in the Hewitson Collection. The dry phase should be larger than the wet, with more falcate primaries and with the under surface more plainly coloured, but with a better-defined dark central line across the wings, if it differs as in the allied species.

38. *Precis aurorina*.

Junonia aurorina, Butler, P. Z. S. 1893, p. 651, pl. lx. fig. 3.

East Africa from Natal to Munisu, Brit. E. Africa. Type, B. M.

This insect runs somewhat close to *P. tugela*, of which it has been regarded as the wet phase. We, however, possess forms representing the wet, intermediate, and dry phases of both, and to unite them as one species would greatly complicate this already difficult group, by proving that in each phase forms with more or less falcate primaries occurred. Therefore until the identity of *P. aurorina* and *P. tugela* can be proved by breeding one from eggs laid by the other, it seems to me more convenient to regard them as different species. In what I call the wet phase of *P. aurorina* the primaries are angulated, the secondaries below are largely ochreous, the whole discal belt being of that colour; in the supposed dry phase the primaries are slightly falcate and the wings below are bright chestnut, irrorated with purplish ash on basal area and external border. We have a long series of an intermediate phase.

39. *Precis tugela*.

Precis tugela, Trimen, Trans. Ent. Soc. 1879, p. 334; S. Afr. Butt. i. p. 241, pl. iv. fig. 5 (1887).

Natal to Nyasaland. B. M.

This always has the primaries strongly falcate and with a long process; but in what I regard as the wet phase the

process is considerably reduced and the apex more angular, the apical portion of the wing from below the falcation to the costal margin being distinctly broader; the under surface with more distinct transverse markings than in the dry phase, without the olivaceous suffusion or sharply defined yellow central line. It is, of course, possible that *P. tugela* may have six developments from extreme wet to extreme dry, and that the first three may represent *P. aurorina* and the last three *P. tugela*, only there is rather a wide break between the third and fourth of these forms, which makes me hesitate to unite them.

40. *Precis pyriformis*.

Junonia pyriformis, Butler, P. Z. S. 1895, p. 726, pl. xlii. figs. 5 & 6 (1896).

East Africa. Type, B. M.

The wet phase is considerably smaller than the dry, has the primaries subfalcate in the male, falcate in the female; the under surface with tolerably defined markings upon a tawny ground, which is slightly washed with lilac on basal area and near to outer margin: the dry phase has the primaries falcate and with well-defined process in both sexes; the under surface with ill-defined markings on a slightly opaline clay-coloured ground. We also have an intermediate phase.

41. *Precis eurodoce*.

Kallima eurodoce, Westwood, Gen. Diurn. Lep. p. 325, note, pl. liv. fig. 1 (1850).

Madagascar.

The wet phase is smaller than the dry, the apex of the primaries subfalcate; the dry phase has the primaries falcate and produced into a long process. — Indeed, the seasonal differences in this species are so marked that it would not take much to convince me that *P. aurorina* and *P. tugela* were forms of one extremely variable species. The wettest phase of *P. aurorina* does not differ more from the driest phase of *P. tugela* than do the wet and dry phases of *P. eurodoce*. By the way, why did not Prof. Aurivillius include this in his collection under *P. milonia*? It differs no more than the other species do.

42. *Precis cælestina*.

Precis cælestina, Dewitz, Nov. Act. Acad. Nat. Cur. xli. 2, p. 193, pl. xxv. fig. 13 (1879).

Northern road to Uganda. B. M.

We have only a dry phase of this species. It nearly approaches *P. chapunga* (an intermediate phase of *P. archesia*), but is, I believe, a good distinct species.

43. *Precis archesia*.

- Papilio archesia*, Cramer, Pap. Exot. iii. p. 44, pl. ccxix. D, E (1779).
Precis Staudingeri, Dewitz, Nov. Act. Acad. Nat. Cur. xli. 2, p. 193, pl. xxv. fig. 15 (1879).
Vanessa pelasgis, Godart, Enc. Méth. ix., Suppl. p. 820 (1823).
Junonia chapunga, Hewitson, Exot. Butt., *Junon.* pl. i. figs. 2, 3 (1864).
Precis semitypica, Aurivillius, Rhop. Æthiop. p. 140 (1893).

S. Africa, northwards to the Victoria Nyanza. B. M.

This species is represented by about seven gradations, the extreme wet phase being *P. pelasgis*; next comes a form with similar pattern on both surfaces, excepting that the orange belt is greatly reduced in width; then *P. chapunga*, followed by *P. semitypica*, *P. archesia* (a larger form, with more conspicuous whiter spots on the primaries), and, lastly, *P. Staudingeri*, the extreme dry phase.

It seems a strange thing that my excellent friend Prof. Aurivillius, who was well aware of the above variability in *P. archesia*, failed to recognize the fact that the nearly related *P. limnoria* was subject to similar variation.

44. *Precis limnoria*.

- Vanessa limnoria*, Klug, Symb. Phys. pl. xlviii. figs. 6, 7 (1845).
Vanessa naib, Guérin, in Lefebvre's Voy. Abyss. pl. xi. figs. 1, 2 (1849).
Precis taveta, Rogenhofer, Ann. Hof-Mus. Wien, vi. p. 460, pl. xv. fig. 7 (1891).
Precis guruana, Rogenhofer, Verh. zool.-bot. Ges. Wien, xli. p. 564 (1891).

Eastern and Northern Africa. B. M.

We have six grades of this species, the extreme wet phase being *P. guruana*, followed by two transitions to the next-named form *P. limnoria*; this is followed by *P. taveta* and concludes with *P. naib*, the extreme dry phase.

45. *Precis andremiaja*.

- Vanessa andremiaja*, Boisduval, Faun. Ent. de Madag. p. 45 (1833).
Vanessa musa, Guérin, Icon. Règne Anim. p. 474 (1884).
Precis Galami, Mabille, in Grand. Madag., Lép. i. p. 137, pl. xiii. figs. 10, 11, pl. xviii. a, figs. 2, 3 (1885-7).
Precis Boisduvali, Staudinger, Exot. Schmett. i. p. 100 (1885).

Madagascar. B. M.

We have all gradations between *P. andremiaja*, the extreme wet phase, and *P. Boisduvali*, the extreme dry phase.

46. *Precis terea*.

Papilio terea, Drury, Ill. Ex. Ent. ii. pl. xviii. figs. 3, 4 (1773).

Western and Equatorial Africa. B. M.

The dry phase appears to be rare.

47. *Precis tereoides*, sp. n.

Allied to *P. terea*, but the orange belt abbreviated, and only indicated by a more or less diffused streak inside the transverse central dark brown line; primaries as strongly falcated at all seasons as in the dry phase of *P. terea*.

Expanse of wings 48–51 millim.

British E. Africa to the Arusa Galla country. B. M.

48. *Precis elgiva*.

Junonia elgiva, Hewitson, Exot. Butt. iii., *Jun.* pl. i. fig. 1 (1864).

Junonia zipha, Butler, Cist. Ent. i. p. 7 (1869).

Southern to British East Africa. B. M.

The locality "Old Calabar" for *P. zipha* must have been incorrect; in our long series we have no West-African example at all approaching *P. elgiva*. This species has a more decided dry phase than *P. terea*—leaf-like below and with violaceous tints.

49. *Precis Goudotii*.

Vanessa Goudotii, Boisduval, Faune Ent. de Madag. p. 45, pl. vii. fig. 1 (1833).

Madagascar. B. M.

We possess only a rather dry phase of this species.

50. *Precis Gregorii*.

Junonia Gregorii, Butler, P. Z. S. 1895, p. 726, pl. xlii. figs. 7, 8.

British East Africa. B. M.

The seasonal phases of this species appear to be very little marked. *P. Gregorii* might almost as correctly be regarded as a form of *P. Goudotii* as of *P. stygia*; but it differs remarkably in outline of wing from both species, although the form of the secondaries is almost that of *P. Goudotii*.

51. *Precis stygia*.

Precis stygia, Aurivillius, Ent. Tidskr. xv. p. 275 (1894).

Precis ethyra, Staudinger (nec Feisthamel), Exot. Schmett. i. p. 102 (1883).

West Africa. B. M.

The extreme dry phase seems to be very rare. It is leaf-

like below, the markings, excepting the stripe across the middle of the secondaries, being ill-defined. Intermediate forms are commoner, but not abundant.

52. *Precis natalica*.

Precis natalica, Felder, Wien. ent. Monatschr. iv. p. 106 (1860).

Junonia chorimene, Hopffer (nec Guérin), in Peters's Reise n. Mossamb., Ins. p. 381 (1862).

Junonia hecate, Trimen, Rhop. Afr. Austr. p. 140, pl. iii. fig. 6 (1862-6).

Southern, Eastern, and Central Africa. B. M.

P. hecate is the intermediate phase; the dry phase has all the white spots on the under surface of the primaries suffused with brownish.

53. *Precis chorimene*.

Vanessa chorimene, Guérin, Icon. Règne Anim. p. 476 (1844).

Vanessa orthosia, Klug, Symb. Phys. pl. xlviii. figs. 8, 9 (1845).

Salamis ethyra, Feisthamel, Ann. Soc. Ent. Fr. (2) viii. p. 250 (1850).

West Africa. B. M.

P. orthosia is the dry phase of the species.

54. *Precis iphita*.

Papilio iphita, Cramer, Pap. Exot. iii. pl. ccix. C, D (1782).

India and Ceylon, Mergui, Pegu, Burma, China, Malacca, and Borneo. B. M.

The dry phase is smaller than the extreme wet phase and has much more falcated primaries, with more uniform and more violaceous under surface, the ocelli being much reduced in size.

55. *Precis intermedia*.

Precis intermedia, Felder, Reise der Nov., Lep. iii. p. 402 (1867).

Celebes. B. M.

I cannot admit the identity of this insect with *P. iphita*; the primaries are always more produced. The dry phase differs from the wet in the paler sandy brown under surface without pearly blue bands.

56. *Precis ida*.

Papilio ida, Cramer, Pap. Exot. i. pl. xlii. C, D (1776).

Apatura tragia, Hübner, Verz. bek. Schmett. p. 35 (1816).

Vanessa idamene, Godart, Enc. Méth. ix. p. 315 (1819).

Java, "Ceylon, Bombay, Nepaul." B. M.

The dry phase of this species somewhat resembles *P. iphita*, but the pale bands are brighter, yellower; the dark basal area always with nearly straight outer edge.

57. *Precis adelaida*.

Precis adelaida, Staudinger, Iris, 1889, p. 51.

Precis neglecta, Swinhoe, Ann. & Mag. Nat. Hist. 1899, vol. iii. p. 103.

Borneo and Philippines. B. M.

The wet phase is extremely like *P. ida*, but is slightly more clouded with brown above; typical *P. adelaida* is probably an intermediate phase, the dry phase being similar but smaller and washed with green above.

58. *Precis hedonia*.

Papilio hedonia, Linnæus, Mus. Lud. Ulr. p. 279 (1764).

Precis hellanis, Felder, Reise der Nov., Lep. iii. p. 402 (1867).

Celebes, Ternate, Mysol, Ceram, Amboina, Ké, Dobbo, Aru, New Guinea, Trobriand, New Britain, New Ireland, Solomon Islands. B. M.

Precis hellanis often (probably always) occurs in the same localities with *P. hedonia*, of which it appears to me to be an intermediate phase; no dry phase is known to me.

59. *Precis zelima*.

Papilio zelima, Fabricius, Syst. Ent. p. 492 (1775); Donovan, Ins. New Holl. pl. xxiii. fig. 2 (1805).

Australia (Queensland, Adelaide). B. M.

This is the Australian representative of *P. hedonia*; it is smaller, never shows the pale external area of that species, and has a fairly well-marked dry phase; its wet phase nevertheless is remarkably close to Ké Island examples of *P. hellanis*, but is more brightly blue-banded below and has smaller ocelli.

60. *Precis atlites*.

Papilio atlites, Johanssen, Amœn. Acad. vi. p. 407 (1764).

Papilio laomedea, Linnæus, Syst. Nat. i. 2, p. 772 (1767).

Eastern India, Ceylon, Nicobars, Andamans, Burma, Malacca, Java, Nias, Sumatra, Borneo, Philippines. B. M.

In the extreme dry phase all the markings on the under surface excepting the central band become indistinct; the ocelli small, with barely a trace of the black spots.

61. *Precis antigone*.

Junonia antigone, Felder, Reise der Nov., Lep. iii. p. 398 (1867).

Precis tristis, Miskin, Blue Book, H.M. Colonial Possessions, no. 103, Brit. New Guinea, pp. 117-124 (1891).

Aru and New Guinea. B. M.

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Miskin's description is not a bad one of undoubtedly this species.

62. *Precis expansa*.

Precis expansa, Butler, P. Z. S. 1883, p. 357.

Ké, Damma, Timor, Timor Laut (type; also Coll. Crowley).
B. M.

63. *Precis erigone*.

Papilio erigone, Cramer, Pap. Exot. i. pl. lxii. E, F (1779).

Java. B. M.

The seasonal phases of this species differ much as in other Oriental forms of *Precis*, but the central bar across the secondaries becomes indistinct in the intermediate and dry phases, as do all the markings on these wings, which in the dry phase become of a nearly uniform pale clay-colour, faintly washed with lilac.

63 a. *Precis Walkeri* (local form of *P. erigone*).

Altogether darker and less ochraceous than *P. expansa*; the pale band and spots on the primaries distinctly paler.

Expanse of wings, ♂ 50, ♀ 53 millim.

Semao Island (*J. J. Walker*). B. M.

This is one of the gradations leading to *P. erigone* from *P. expansa*; the following is another:—

63 b. *Precis celebensis* (local form of *P. erigone*).

Differs from *P. erigone* in its slightly more ruddy colouring, the costa of the primaries rather longer, the row of connected ocelli on the secondaries with more brightly orange irides than in the wet phase of *P. erigone*.

Expanse of wings 56 millim.

Celebes. B. M.

64. *Precis lemonias*.

Papilio lemonias, Linnæus, Mus. Lud. Ulr. p. 277 (1764).

Papilio aonis, Linnæus, Syst. Nat. i. 2, p. 769 (1767).

India, Burma, China, Formosa, Philippines, Lankowi, Penang, Malacca. B. M.

The dry phase is slightly marked and often rosy on the under surface.

65. *Precis timorensis*.

Junonia timorensis, Wallace, Trans. Ent. Soc. 1869, p. 346.

Junonia valesca, Frühstorffer, Berl. ent. Zeit. xliii. p. 181 (1898).

Timor, Sumba (Crowley Coll.). B. M.

J. valesca is the wet phase, as Herr Frühstorffer supposed.

66. *Precis iona*.

Junonia iona, Grose-Smith, Novit. Zool. i. p. 350 (1894).

New Guinea (Crowley Coll.). B. M.

67. *Precis rhadama*.

Junonia rhadama, Boisduval, Faune Ent. de Madag. p. 44, pl. vii. fig. 2 (1833).

Madagascar, Mauritius, Rodriguez, Johanna. B. M.

In the dry phase, as usual, the markings of the under surface are confused, the white markings being suffused with grey, the white central band of the secondaries replaced by a yellow one, and the ocelli indistinct and reduced in size.

68. *Precis touhilimasa*.

Junonia touhilimasa, Vieillot, Ann. Soc. Ent. France, lxi. Bull. p. 148 (1892).

Junonia pavonina, Butler, P. Z. S. 1895, p. 257, pl. xvi. figs. 1-3.

Fwambo, and between Tanganyika and Nyasa. B. M.

J. touhilimasa is the wet phase answering to my fig. 3; figs. 1 and 2 are the dry phase.

69. *Precis artaxia*.

Junonia artaxia, Hewitson, Exot. Butt. iii., *Jun.* pl. i. fig. 6 (1864).

Precis Nachtigalli, Dewitz, Nov. Act. Acad. Nat. Cur. xli. 2, p. 194, pl. xxv. fig. 16 (1879).

Mashonaland, Portuguese E. Africa, Nyasa, Fwambo. B. M.

The seasonal phases of this species differ much as in *P. touhilimasa*; *P. artaxia* is the dry phase and *P. Nachtigalli* the wet. In all collections obtained during both wet and dry seasons we have received both forms.

70. *Precis almana*.

Papilio almana, Linnæus, Mus. Lud. Ulr. p. 272 (1764).

Papilio asterie, Linnæus, Syst. Nat. i. 2, p. 769 (1767).

Junonia nikobariensis, Felder, Verh. zool.-bot. Ges. Wien, xii. p. 482 (1862).

Junonia javana, Felder, l. c. p. 487 (1862).

Junonia sumbae, Doherty, J. A. S. B. ix. p. 172 (1891).

India, Ceylon, Andamans, Mergui, Pegu, Burma, Siam, Malacca, Penang, Sumatra, Java, Philippines, Formosa, China, Celebes.

As is now well known, *P. asterie* is the wet phase and *P. almana* the dry; the intermediate phase retains the outline of the wet, but the under-surface colouring approaches

that of the dry phase; nevertheless all intermediate examples are not absolutely constant, some showing more falcation of the primaries than others. The local variations are not constant enough to deserve names, but examples from Western China tend to have smoky secondaries; and an example which we have from the Celebes is of a smoky ochraceous tint over the whole upper surface; examples from Java are usually rather small, but not smaller than many other examples of the species. The characters upon which the var. *sumbæ* is separated are extremely variable: the upper ocellus of the primaries is sometimes almost lost in the black bar from costa, and the lower ocellus partly enclosed in a black patch in Indian examples; the lower ocellus in the secondaries is sometimes quite large, at others almost obliterated; the uppermost ocellus on the under surface of primaries is sometimes well-formed, with defined pupil, sometimes reduced to a fine point; the upper pair on the secondaries exhibits great variation as regards separation, and the lines on the under surface are frequently almost entirely red-brown instead of black; the pale bands on the under surface also vary in number, the wettest phase showing them most distinctly.

XXX.—*Notes from the Gatty Marine Laboratory, St. Andrews.*—No. XXI. By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.

[Plate I.]

1. On some Points in the Life-history of the Littoral Fishes.
2. On Japanese Annelids—*Nephtys* and *Eteone*.
3. On Norwegian Annelids collected by Canon Norman.
4. On Canadian *Phyllodoce* collected by Mr. Whiteaves.
5. On certain *Hesionidæ* from the 'Porcupine' Expedition of 1870.

1. *On some Points in the Life-history of the Littoral Fishes* *.

No group of marine fishes is better fitted for demonstrating the great mortality which ensues between the period of the deposition of the ova and the adult condition than the littoral fishes, such as the Shanny, Cottus, Gunnel, and Viviparous Blenny. This is especially true of such a form as the Shanny, the adults of which can, as a rule, be readily located on rocky shores in the pools between tide-marks.

* Communicated to the Bradford Meeting of the British Association, 1900.